(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
22 February 2001 (22.02.2001)

PCT

(10) International Publication Number
WO 01/12902 A1

(51) International Patent Classification[7]: D21H 27/32, 27/38, B32B 29/00 // D21H 11/12

(21) International Application Number: PCT/US00/22691

(22) International Filing Date: 17 August 2000 (17.08.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/377,281 19 August 1999 (19.08.1999) US

(71) Applicant: THE PROCTER & GAMBLE COMPANY [US/US]; One Procter & Gamble Plaza, Cincinnati, OH 45202 (US).

(72) Inventors: NOBLES, Kevin, Wendell; 1530 Northview Avenue #1, Cincinnati, OH 45223 (US). DUGAS, Michael, Bernard; 727 Barney Avenue, Wyoming, OH 45215 (US). STEINHARDT, Mark, John; 8387 Chesney Lane, Cincinnati, OH 45249 (US). BARDON, Leah, Michele; 7435 Placid Lake Drive #207, Mason, OH 45040 (US). BOYLE, Kristin, Ann; 5 Ohio Avenue, Ft. Thomas, KY 41075 (US). YOUNG, Terrill, Alan; 2607 Mount Airy Avenue, Cincinnati, OH 45239 (US).

(74) Agents: REED, T., David et al.; The Procter & Gamble Company, 5299 Spring Grove Avenue, Cincinnati, OH 45217-1087 (US).

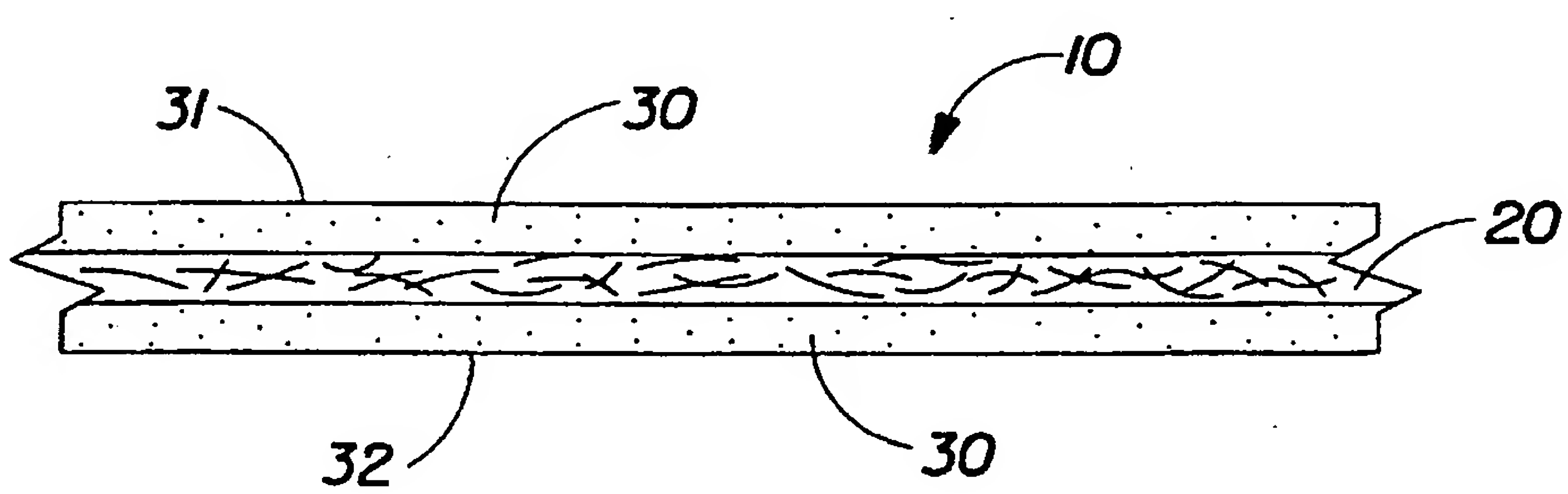
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KR (utility model), KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *With international search report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: A MULTI-PLY TISSUE HAVING A HIGH CALIPER, LOW DENSITY, ABSORBENT LAYER



(57) Abstract: A tissue product having a high caliper, low density, absorbent inner layer is provided. The high caliper, low density, absorbent inner layer can comprise passively bonded or actively bonded, hydrophilic fibers. The passively bonded, hydrophilic fibers can include natural fibers such as cotton and air blown pulp or synthetic fibers. The actively bonded hydrophilic fibers can comprise wet laid cellulose or nonwovens. The inner layer can have a caliper ranging from about 0.010 inches to about 0.030 inches and an apparent density of less than about 0.11 g/cm³.

WO 01/12902 A1

A MULTI-PLY TISSUE HAVING A HIGH CALIPER, LOW DENSITY, ABSORBENT LAYER

FIELD OF THE INVENTION

The present invention relates to tissue products, and more particularly to tissue products having a high caliper, low density, absorbent inner layer.

BACKGROUND OF THE INVENTION

Cellulosic fibrous structures, such as paper webs, are well known in the art. Such paper webs can be used for facial tissues, toilet tissue, paper towels, and napkins, each of which is in widespread use today. If these products are to perform their intended tasks and find wide acceptance, the fibrous structure should exhibit suitable properties in terms of absorbency, bulk, strength, and softness.

Additionally, there is a desire to make such paper webs having increased ability to stop certain fluids from passing through the web during use. For example, for facial tissues, it is desirable to stop the passage of bodily fluids during sneezing, coughing, nose blowing, and the like. These bodily fluids pose a heath risk due to the presence of bacteria, germs, or other pathogens. Once pathogens carried by mucous, saliva, or other droplets of bodily fluids pass through a facial tissue, they can remain on the hands of the user, thereby providing a means for transmission of germs, and possibly disease. The transfer of pathogens from person to person is known to frequently occur from hand to hand contact. Furthermore, it appears that the only defense against many viral diseases, including the common cold, is the prevention of their spread.

In order to prevent fluids from passing through the tissue during use, consumers perform various compensating actions. For example, many consumers have been known to fold a tissue in half or select several tissues at once prior to use in order to enhance absorbency and strength as well as provide an improved barrier to prevent the fluids from

wetting their hands. Such practices may be adequate in preventing hand wetting during use, however, they largely increase product consumption.

To prevent the spread of germs, bacteria, and other pathogens, attempts have been made to provide barrier layers in tissue products. For example, one or more plies of tissue may be treated with a substance designed to entrap and contain droplets of fluids. However, such substances may not form a complete barrier to the passage of fluids, particularly small droplets which can readily "strikethrough" tissue paper, or liquid that can be rapidly absorbed through. Therefore, treated tissues may not be capable of preventing the contamination of the hands of the user.

Other attempts at providing an effective barrier layer include the inclusion in the one or more plies of a waterproof pliable plastic material between the layers of the facial tissue. For example, U.S. Patent. No. 5,196,244 to Beck teaches a very thin, pliable material (e.g., polyethylene) incorporated between the layers of a tissue and held in place by embossing. However, plastic films can decrease flexibility as well as increase the noise of the tissue in use. Additionally, for safety reasons (e.g., to prevent accidental suffocation) it is important that the tissue remain air or vapor permeable to a certain extent.

U.S. Patent No. 4,885,202, to Lloyd et al., teaches the use of meltblown fibers intimately overall thermally bonded between two outer tissue plies for wet strength. However, the required thermal bonding can add stiffness adversely affecting drape and softness of the tissue product as well as increase the manufacturing costs.

Attempts have been made in the art of disposable absorbent bandages to provide absorbent fluff structures which distribute absorbed fluids, act as a partitioning agent, etc. Disposable absorbent bandages typically include baby diapers, adult incontinence products and sanitary napkins, which are subject to repeated and heavy loadings of bodily fluids. One such attempt in this art is shown in commonly assigned U.S. Patent Nos. 4,141,772 issued February 27, 1979 and 4,217,078 issued August 12, 1980, both issued to Buell and incorporated herein by reference. Buell '772 and Buell '078 teach an airlaid web comprising a 5 ply laminate having 2 airfelt plies, 2 tissue plies, and a central

reinforcing ply. Such a construction, while suitable for absorbent bandages and distributing fluids, would be infeasible for the present invention. The Buell construction shows two distinct airfelt layers separated by a reinforcing ply. This arrangement, while feasible for disposable absorbent bandages would yield a product too thick and too stiff for use as a facial or bath tissue, etc. Furthermore, the intent of the facial tissue is to trap and prevent the spread of bodily fluids - rather than distribute such bodily fluids throughout the product in order to accommodate subsequent loadings.

Accordingly, it would be desirable to provide a tissue product providing sufficient absorption, softness, and hand protection without requiring the consumer to perform compensating actions.

SUMMARY OF THE INVENTION

Disclosed is a tissue product comprising two outer cellulosic plies, and inner layer. The inner layer can be composed of passively bonded or actively bonded, hydrophilic fibers forming a high caliper, low density absorbent layer. The passively bonded, hydrophilic fibers can include natural fibers such as cotton and air blown pulp or synthetic fibers. The actively bonded hydrophilic fibers can comprise wet laid cellulose or synthetic nonwovens. The inner layer can have a caliper ranging from about 0.010 inches to about 0.030 inches and an apparent density of less than about 0.11 g/cm^3.

The tissue product can have a total caliper ranging from about 0.026 inches to about 0.044 inches, an absorbency ranging from about 15 g/g to about 30 g/g, a compressibility ranging from 20% to 99%, and a percent rebound ranging from about 30% to about 99%.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a cross-sectional view of a paper web having a liquid impermeable, breathable barrier layer according to the present invention.

Figure. 2 is a schematic, side elevational representation of an apparatus for making a liquid impermeable, breathable paper web having a barrier layer according to the present

invention.

Figure 3 is a plan view of an alternative embodiment, shown partially in cutaway, of a paper web of the present invention, showing adhesive bonding along at least two edges.

Figure 4 is a plot of a typical output for a bending stiffness test.

Figure 5 is a linear regression analysis of the bending stiffness output in Figure 4.

DETAILED DESCRIPTION OF THE INVENTION

Definitions

As used herein, the following terms have the following meanings:

Basis weight is the weight per unit area of a sample reported in lbs/3000 ft^2 (grams per square meter).

Caliper is the macroscopic thickness of a sample measured as described below.

Apparent density is the basis weight of the sample divided by the caliper with appropriate unit conversions incorporated therein. Apparent density used herein has the units of grams / centimeters cubed (g/cm^3).

Machine direction, designated MD, is the direction parallel to the flow of the fiber structure through the product manufacturing equipment.

Cross machine direction, designated CD, is the direction perpendicular to the machine direction in the same plane of the tissue product.

Absorbency is the ability of a material to take up fluids by various means including capillary, osmotic, solvent or chemical action and retain such fluids.

Flexibility is a measure of deformation under a given load without being broken and with or without returning of itself to its former shape.

A fiber is a slender object having a major axis which is very long compared to the two orthogonal axes and having an aspect ratio of at least 4/1, preferably at least 10/1.

Hydrophilic refers to materials having an affinity for attracting or absorbing water.

A "paper web" or "cellulosic paper web" refers to the web of the present invention, which comprises at least one component layer comprising passively bonded, hydrophilic fibers. For example, the web of the present invention comprises passively bonded, hydrophilic fibers between cellulosic paper layers.

The term "ply" means an individual web component to be disposed in a substantially contiguous, face to face relationship with other plies, forming a multiple ply web of the present invention. It is also contemplated that a single web component can effectively form two "plies", for example, by being folded on itself. Therefore, a cellulosic layer folded on itself, with a layer of passively bonded, hydrophilic fibers inserted between the two folded portions would effectively form a three ply web of the present invention. Likewise, a component ply folded upon itself without any additional plies inserted between the folded portions would effectively form a two ply web.

The term "liquid" refers primarily to bodily fluids, such as water, mucous, saliva, blood and other body fluids, but may also include other liquids. "Liquid" refers to liquid fluids, as opposed to gaseous or vapor fluids. Certain body fluids, such as mucous, may have very high viscosities, but are still considered liquids for the purposes of the present invention.

As used herein, by "passive bonding" when referring to fiber-to-fiber bonds it is meant bonding in the absence of some external medium such as hydrogen molecular bonds or adhesive bonds, enabling the fibers to slide relative to one another when disturbed by external forces. Per this definition, the tensile strength of a layer comprising passively bonded fibers is typically less than about 130 grams. Passive bonding is generally very light, and represents the natural affinity of materials to remain in contact once placed in contact with one another. For example, passive bonding may be due to inherent static electric charges or cohesive forces. Passive bonding can also refer to the bonding that occurs when two plies of material are brought into contact with one another, such that the materials cohesively attach to one another.

As used herein, by "active bonding" when referring to fiber to fiber bonds is meant bonding via an external medium such as hydrogen bonds or adherent bonding with agents

such as adhesives or latex. Per this definition, the tensile strength of a layer comprising actively bonded fibers is typically greater than about 130 grams. Active bonding when referring to bonds between plies can also include adhesive bonds as well as thermal or ultrasonic bonds, embossing, needling and other mechanical engagement means.

With reference to FIG. 1, the present invention comprises a tissue product 10, which, in a preferred embodiment is a facial tissue. Tissue product 10 comprises at least one high caliper, low density, absorbent inner layer 20, disposed between and contiguous with at least two outer cellulosic paper webs 30. The high caliper, low density, absorbent inner layer 20 can comprise passively bonded or actively bonded, hydrophilic fibers. The passively bonded, hydrophilic fibers can include natural fibers such as cotton and air blown pulp as well as bicomponent synthetic fibers composed of polyethylene and polypropylene treated with surfactant for hydrophilicity. The actively bonded fibers can include wet laid cellulose or synthetic nonwovens.

While the embodiment illustrated comprises three plies, such an embodiment is not limiting. In practice, it may be desirable to form a multi-ply tissue product comprising various combinations of high caliper, low density, absorbent plies disposed between and contiguous with cellulosic paper webs. Such various combinations are also contemplated and considered to be within the scope of the present invention.

The benefits of the present invention includes providing tissue product having absorption capacity via the inner layer that enables consumers to use the product without experiencing hand wetting and without the need for compensating action such as folding or multiple tissues. As a result, the tissue product of the present invention can be provided in reduced sizes while providing the performance of a standard full size article. For example, as a facial tissue the standard article size is about 72.6 inches^2. The size of the tissue product of the present invention can range from a low limit of about 15 inches^2 or a low limit of about 40 inches^2 to a high limit of about 200 inches^2 or a high limit of about 60 inches^2. In one embodiment, size of the tissue product is about 49.5 inches^2.

The benefits of the present invention are not limited to facial tissue embodiments. For example, bath tissue, commonly termed toilet paper, may also benefit from the

attributes of the high caliper, low density, absorbent inner layer. Having a soft, flexible, absorbent bath tissue can eliminate the unpleasant experience of wet fingers or hands during or after use. Furthermore, paper webs of the present invention may be useful as paper towels, napkins, and the like.

Tissue product 10 may be prepared as a single sheet for use as a facial tissue, napkin, paper towel, or bath tissue, depending on the type of paper used for the cellulosic paper webs. A plurality of paper webs 10 may also be provided on a roll having perforations to define individual web sections where each section is removable for use, such as is commonly used for bath tissue (e.g., toilet paper). If prepared as bath tissue, roll dispensing is the preferred method of use, and paper such as found in the commercially successful CHARMIN® brand tissue paper can be used as the cellulosic paper layer. However, in a preferred embodiment, a plurality of paper webs 10 can be cut, folded, and optionally interleaved into a stack of facial tissues suitable for dispensing from a container, such as a box or tub. In this embodiment, paper such as found in the commercially successful PUFFS® brand facial tissue can be used as the cellulosic paper layer. CHARMIN® tissue paper and PUFFS® facial tissue are both marketed by the instant assignee, The Procter & Gamble Co. of Cincinnati, OH.

Cellulosic Paper Webs

Cellulosic paper webs 30 may be creped paper webs consisting essentially of cellulosic papermaking fibers. The paper webs can have a basis weight range where the low limit of the range can be about 10 grams per square meter (gsm or g/m^2) per ply, about 13 g/m^2 per ply, or about 15 g/m^2 per ply. The high limit of the basis weight range can be about 100 g/m^2 per ply, about 40 g/m^2 per ply, or about 25 g/m^2 per ply. The cellulosic paper webs 30 can be creped, uncreped, or wet microcontracted tissue webs suitable for use as facial tissue or premium facial tissue. Generally, identical paper webs 30 are used, that is, substantially identical in basis weight, thickness, composition and other properties. However, it is contemplated that certain benefits may be realized by using paper webs having differing properties. For example, the component paper webs 30 may differ in basis weight, thickness, composition, or other properties, providing one side of the paper web with a relatively smooth surface, and one side having a relatively rough

surface.

Cellulosic paper webs 30 of the present invention may be made by conventional processes known in the art for producing tissue paper useful for facial tissues, toilet tissue, paper towels, or napkins. However, cellulosic paper webs 30 of the present invention can be made by through air drying processes by use of a patterned resinous papermaking belt. A patterned resinous papermaking belt can comprise two primary components: a framework and a reinforcing structure. The framework can comprise a cured polymeric photosensitive resin.

One surface of the patterned resinous papermaking belt contacts one surface, for example, first surface 31, of the cellulosic paper webs 30 carried thereon. During papermaking, this surface of the patterned resinous papermaking belt may imprint a pattern onto the first surface 31 of cellulosic paper webs 30 corresponding to the pattern of the framework.

A patterned resinous papermaking belt suitable for making a preferred embodiment of the present invention may be made according to any of commonly assigned U.S. Patents: 4,514,345, issued April 30, 1985 to Johnson et al.; 4,528,239, issued July 9, 1985 to Trokhan; 5,098,522, issued March 24, 1992; 5,260,171, issued Nov. 9, 1993 to Smurkoski et al.; 5,275,700, issued Jan. 4, 1994 to Trokhan; 5,328,565, issued July 12, 1994 to Rasch et al.; 5,334,289, issued Aug. 2, 1994 to Trokhan et al.; 5,431,786, issued July 11, 1995 to Rasch et al.; 5,496,624, issued March 5, 1996 to Stelljes, Jr. et al.; 5,500,277, issued March 19, 1996 to Trokhan et al.; 5,514,523, issued May 7, 1996 to Trokhan et al.; 5,554,467, issued Sept. 10, 1996, to Trokhan et al.; 5,566,724, issued Oct. 22, 1996 to Trokhan et al.; 5,624,790, issued April 29, 1997 to Trokhan et al.; and 5,628,876, issued May 13, 1997 to Ayers et al., the disclosures of which are incorporated herein by reference.

The cellulosic paper webs 30 of the present invention can have two primary regions. The first region comprises an imprinted region which is imprinted against the framework of a patterned resinous papermaking belt. The imprinted region preferably comprises an essentially continuous network. The continuous network of the first region

of the cellulosic paper webs 30 is made on the essentially continuous framework of the patterned resinous papermaking belt and will generally correspond thereto in geometry and be disposed very closely thereto in position during papermaking.

The second region of the cellulosic paper webs 30 can comprise a plurality of domes dispersed throughout the imprinted network region. The domes generally correspond in geometry, and during papermaking in position, to the deflection conduits in the patterned resinous papermaking belt. The domes protrude outwardly from the essentially continuous network region of the paper, by conforming to the deflection conduits during the papermaking process. By conforming to the deflection conduits during the papermaking process, the fibers in the domes are deflected in the Z-direction between the paper facing surface of the framework and the paper facing surface of the reinforcing structure. Preferably the domes are discrete.

The cellulosic paper webs 30 according to the present invention may be made according to any of commonly assigned U.S. Patents: 4,529,480, issued July 16, 1985 to Trokhan; 4,637,859, issued Jan. 20, 1987 to Trokhan; 5,364,504, issued Nov. 15, 1994 to Smurkoski et al.; and 5,529,664, issued June 25, 1996 to Trokhan et al. The cellulosic paper webs may have certain lotions or emollients added, for example according to any of commonly assigned U.S. Patents: 4,481,243, issued November 6, 1984 to Allen; and 4,513,051 issued April 23, 1985 to Lavash. The disclosures of all the above-mentioned patents are hereby incorporated herein by reference.

If desired, the cellulosic paper webs 30 may be dried and made on a through-air drying belt not having a patterned framework. Such cellulosic paper webs 30 may have discrete, high density regions and an essentially continuous low density network. During or after drying, the cellulosic paper webs 30 may be subjected to a differential vacuum to increase its caliper and desensify selected regions. Such paper, and the associated belt, may be made according to the following patents: 3,301,746, issued Jan. 31, 1967 to Sanford et al.; 3,905,863, issued Sept. 16, 1975 to Ayers; 3,974,025, issued Aug. 10, 1976 to Ayers; 4,191,609, issued March 4, 1980 to Trokhan; 4,239,065, issued Dec. 16, 1980 to Trokhan; 5,366,785 issued Nov. 22, 1994 to Sawdai; and 5,520,778, issued May 28, 1996

to Sawdai, the disclosures of which are incorporated herein by reference.

The reinforcing structure may be a felt, also referred to as a press felt as is used in conventional papermaking without through-air drying. The framework of a patterned resinous papermaking belt may be applied to the felt reinforcing structure as taught by commonly assigned U.S. Patents 5,556,509, issued Sept. 17, 1996 to Trokhan et al.; 5,580,423, issued Dec. 3, 1996 to Ampulski et al.; 5,609,725, issued Mar. 11, 1997 to Phan; 5,629,052 issued May 13, 1997 to Trokhan et al.; 5,637,194, issued June 10, 1997 to Ampulski et al. and 5,674,663, issued Oct. 7, 1997 to McFarland et al., the disclosures of which are incorporated herein by reference.

The cellulosic paper webs 30 of the present invention may optionally be foreshortened, as known in the art. Foreshortening can be accomplished by creping the cellulosic paper webs 30 from a rigid surface, and preferably from a cylinder. A Yankee drying drum is commonly used for this purpose. Creping is accomplished with a doctor blade as is well known in the art. Creping may be accomplished according to commonly assigned U.S. Patent 4,919,756, issued April 24, 1992 to Sawdai, the disclosure of which is incorporated herein by reference. Alternatively or additionally, foreshortening may be accomplished via wet microcontraction as taught in commonly assigned U.S. Patent 4,440,597, issued April 3, 1984 to Wells et al., the disclosure of which is incorporated herein by reference.

High Caliper, Low Density, Absorbent Inner Layer

Aside from simply preventing the spread of airborne fluid droplets, the paper web of the present invention is likewise useful for keeping the hands of the user dry during acts related to sneezing, nose blowing, and the like. For example, post sneeze or nose blowing wiping and cleaning can often leave the fingers or hands of the user wet. As a result, the user often folds a single tissue in half or uses several tissues at once in order to guard against the wetness. The high caliper, low density, absorbent inner layer of the present invention can prevent a user from experiencing such undesirable wetness without having to fold or apply multiple tissues at once. The high caliper, low density, absorbent inner layer 20 can comprise either passively bonded or actively bonded hydrophilic fibers.

Passively bonded hydrophilic fibers include cotton batting formed into a nonwoven web such that it can be stored as roll stock for use in the papermaking process. Alternatively, passively bonded hydrophilic fibers can comprise natural fibers such as cotton fibers or air blown pulp or synthetic fibers such as bicomponent fibers composed of polyethylene and polypropylene treated with a surfactant in order to provide hydrophilicity. Such natural or synthetic fibers can be introduced between the outer cellulosic plies via an air forming process. In the air forming process, a first paper web is laid onto an air permeable forming wire. The forming wire and web pass through a vacuum section where dry cotton or pulp fibers are fed into a moving air system and vacuumed onto the first paper web. The forming wire, first paper web, and layer of dry fibers exit the vacuuming section and are covered by a second paper web.

Actively bonded hydrophilic fibers can include wet laid cellulosic webs and nonwovens. Wet laid cellulosic webs providing a high caliper, low density, absorbent inner layer can be made by the through air drying process previously described using patterned resinous papermaking belts. The wet laid webs providing a high caliper, low density, absorbent inner layer can comprise single or multiple lamina cellulosic structures, each lamina having three or more identifiable regions which may be distinguished from one another by intensive properties as taught in U.S. Patent No 5,843,279 issued Phan et al. December 1, 1998 which is incorporated herein by reference. The intensive properties that may be used to identify and distinguish different regions of the fibrous structure are basis weight, thickness, density and projected average pore size.

Where the high caliper, low density, absorbent inner layer 20 comprises a cotton batting, cellulosic webs or nonwovens, the inner layer 20 can be processed into the tissue product 10 by a combining apparatus 200, as shown in FIG. 2. In the configuration shown, cellulosic webs 30 can be drawn off rolls 230 and the high caliper, low density, absorbent inner layer 20 can be drawn off roll 240. The inner layer 20 and cellulosic web plies 30 can be combined into web 10 of the present invention by drawing through combining rollers 250, which bring the component plies into intimate contact, and may compress the component plies to achieve passive bonding therebetween.

Multi-ply Tissue Product

The outer cellulosic plies of the multi-ply tissue product of the present invention can be formed by either passively or actively bonding the outer cellulosic plies to opposite sides of the inner high caliper low density inner layer. Passive bonding provides relatively little bond strength between the plies, to hold the plies together for normal use. When used as a folded and stacked tissue as well as core wound tissue, the tissue product 10 of the present invention exhibits sufficient ply-to-ply bonding to prevent unintentional debonding of the plies. Without being bound by theory, it is believed that the passive bonding of the plies may be due to static electric charges present in the materials, and may be somewhat variable due to other factors, for example, relative moisture levels in the ply components. Also, light active bonding may occur due to mechanical bonding of the exposed fibers of the inner layer 20 to contacting fibers of cellulosic webs 30. The mechanical bonding may be analogous to "hook and loop" fasteners, wherein bonding is facilitated by the engagement of male and female members of the constituent components.

The plies of the tissue product 10 of the present invention can be passively bonded by the method disclosed above with reference to the apparatus shown in FIG. 2. However, if desired, it is contemplated that a certain amount of adhesive or other active bonding means could be added to provide additional adhesion to portions of the component plies. For example, needling, embossing, or other thermal or mechanical bonding means could be used to actively bond the paper web 30 near some or all of the edges of paper web 30, thereby providing increased resistance to undesired delamination of the component plies.

Joining may also be by ultrasonic bonding or autogeneous bonding as disclosed in U.S. Patent No. 4,919,738 issued April 24, 1990 to Ball et al., or other bonding methods known in the art. For example, if the edges of the inner layer or layers are coextensive with the edges of the outer plies, adhesive bonding may not provide active bonding, depending on the adhesive used, and the surface energy characteristics of the inner layer. In this case, mechanical bonding may be more desirable, for example by mechanical bonding at a mechanical bonding station after formation of the multiple ply web. FIG. 2 shows a mechanical bonding station 270, which may be embossing rollers, ultrasonic

bonding means, needling means, or other non-adhesive bonding methods.

As shown in FIG. 3, a tissue product 10 of the present invention may be comprised of two outer cellulosic plies 30, and a high caliper, low density, absorbent inner layer 20 comprising cotton batting, cotton fibers, or air blown pulp, as disclosed above, wherein the inner layer has a smaller width dimension W1 than the width dimension W2 of the outer cellulosic plies. By placing the inner layer having a smaller width dimension W1 between the two outer plies, the two outer cellulosic plies may be joined at the edges in a bonding region 25, such as by a strip of adhesive. Joining, or bonding, may be accomplished by a continuous strip of adhesive, a discontinuous strip, such as spots of adhesive, or per the teachings of commonly assigned U.S. Patent No. 5,143,776, issued to Givens, the disclosure of which is incorporated herein by reference. In one embodiment, adhesive can be applied along opposing longitudinal edges in the machine direction by a print applicator 260, as shown in FIG. 2. Print applicator 260 may be a rolling applicator, such as a gravure roller, or it may be a spray applicator, or other adhesive applicator known in the art.

Alternatively, the inner high caliper, low density absorbent ply may have a smaller surface area than the two outer plies such that the two outer plies can be joined along edges forming a perimeter encompassing the inner layer. For the present, the perimeter can occupy less than 30% of the total surface area of the tissue product; preferably the perimeter can occupy less than 20% of the total surface area; and more preferably the perimeter can occupy less than 10 % of the total surface area.

While FIG. 3 illustrates a high caliper, low density, absorbent inner layer having a smaller width dimension than the outer layers, it is understood that other dimensional configurations are possible, with the only limitation being that the outer layers be joined at certain portions, such as one or more of the edges. For processing economies, it is contemplated that the preferred configuration is as illustrated, i.e., making the width dimension (corresponding to the cross machine dimension) smaller. In this manner, active bonding (such as adhesive, mechanical, autogeneous, etc.) can be done continuously in the length dimension (corresponding to the machine direction) during

continuous web processing.

Material Properties

Tissue products such as disposable towels, toilet tissue, facial tissue, napkins and wet wipes manifest various physical characteristics which include basis weight and apparent density, both of which have been previously defined. Basis weight and apparent density relate to bulkiness of the tissue product providing consumer confidence that hands will remain dry after use without having to perform compensating actions. For the present invention, the entire tissue product can have a basis weight ranging from about 20 lbs/3000 ft^2 (33 g/m^2) to about 80 lbs/3000ft^2 (130 g/m^2) while the basis weight of the high caliper, low density, absorbent inner layer can range from about 8 lbs/3000 ft^2 (13 g/m^2) to about 16 lbs/3000ft^2 (26 g/m^2). More preferably, the tissue product can have a basis weight of about 30 lbs/3000 ft^2 (49 g/m^2), while the high caliper, low density, absorbent inner layer can have a basis weight of about 12 lbs/3000ft^2 (20 g/m^2). Moreover, the tissue product of the present invention can have an apparent density range having a low limit of about 0.04 g/cm^3 or about 0.06 g/cm^3. Likewise, the apparent density range can have a high limit of about 0.12 g/cm^3 or or of about 0.08 g/cm^3. In one embodiment, the tissue product of the present invention has an apparent density of about 0.07 g/cm^3. Furthermore, the high caliper, low density, absorbent inner layer of the tissue product can have an apparent density less than about 0.11 g/cm^3 or less than about 0.06 g/cm^3.

For the present invention, the tissue product can have a caliper ranging from about 0.026 inches to about 0.044 inches which is largely attributed to the high caliper, low density, absorbent inner layer which can account for 50% or 66% of the caliper of the entire product. The caliper of the high caliper, low density, absorbent inner layer can range from a low limit of about 0.010 inches, or about 0.014 inches. In addition, the caliper range of the inner layer can have a high limit of about 0.030 inches or a high limit of about 0.24 inches.

Softness has been described as a physiologically perceived attribute which is generally measured by expert or non-expert panel evaluations. Perceived softness can be broken down into two components; bulk softness and surface softness. Surface softness

has been related to surface texture and smoothness while bulk softness has been correlated to mechanical properties such as compressibility and resiliency as well as flexibility. Compressibility is a measure of the product's ability to be reduced in volume by application of pressure. Resiliency is the product's ability to recover its size and form following deformation. Flexibility is related to sheet rigidity.

The tissue product of the present invention can have a compressibility, measured as described hereunder, ranging from a low limit of about 20% or a low limit of about 40%. The high limit of the compressibility range can be about 99%, about 70%, or about 43%.

The resiliency of the tissue product of the present invention is measured in terms of its ability to recover from a compressed state. The method used in measuring the tissue products recovery is measured in terms of percent rebound as described below. For the present invention, the tissue product can have a percent rebound range having a low limit of about 30%, or about 65%. The high limit of the percent rebound range can be about 99% or about 85%.

High softness requires flexibility. Flexibility is a function of rigidity which is a measure of bending stiffness of the material. For the present invention, the rigidity of the tissue product was measured in the CD and the MD. The method used for measuring the rigidity is described below. For the present invention, the tissue product can have a CD rigidity ranging from about 0.018 $gf*cm^2/cm$ to about 0.373 $gf*cm^2/cm$ and a MD rigidity ranging from about 0.008 $gf*cm^2/cm$ to about 0.235 $gf*cm^2/cm$.

Products such as disposable towels, toilet tissue, facial tissue, napkins, and wet wipes require a certain level of absorbency. Herein, absorbency means absorbent capacity which is a measure of the amount of distilled water absorbed and retained by the structure. The hydrophilic fibers of the high caliper, low density, absorbent inner layer of the present invention promotes capillary action and the corresponding absorbency of the tissue product. The method used for determining the absorbency of the tissue product is described below. For the present invention, the tissue product can have an absorbency range with a low limit of about 15 $g_{Water}/g_{Dry\ Structure}$; or about 19 $g_{Water}/g_{Dry\ Structure}$. The high

limit of the absorbency range can be about 30 $g_{Water}/g_{Dry\ Structure}$, or about 25 $g_{Water}/g_{Dry\ Structure}$.

Analytical Methods

(a) Sample Conditioning And Preparation:

Prior to testing, samples are conditioned at a relative humidity of 48% to 50% and within a temperature range of 22°C to 24°C until a moisture content of from about 5% to about 16% by weight as measured by TGA (Thermo Gravimetric Analysis) is achieved. For Thermo Gravimetric Analysis, a Hi-res. TGA2950 Termogravimetric analyzer from TA Instruments is used. Approximately 20 mg of sample is weighed into a TGA pan. Following the manufacturer's instructions, the sample and pan are inserted into the unit and the temperature is increased at a rate of 10°C/minute to 250°C. The % moisture in the sample is determined using the weight lost and the initial weight as follows:

$$\%\ \text{Moisture} = \frac{\text{Start Weight} - \text{Weight @ } 250°\text{C}}{\text{Start Weight}} * 100\%$$

where all weights are in milligrams.

(b) Basis Weight

One stack of 8 plies is made from the preconditioned samples. The stack of 8 plies is cut into a 4 inch by 4 inch square. A rule die from Acme Steel Rule Die Corp. (5 Stevens St. Waterbury Conn., 06714) is used to accomplish this cutting.

For the actual measurement of the weight of the sample, a top loading balance with a minimum resolution of 0.01 g is used. The stack of 8 plies is laid on the pan of the top loading balance. The balance is protected from air drafts and other disturbances using a draft shield. Weights are recorded when the readings on the balance become constant. Weights are measured in grams.

The weight reading is divided by the number of plies tested. The weight reading is also divided by the area of the sample which is normally 16 square inches, which is approximately equal to 0.0103 square meters.

The unit of measure for basis weight as used herein is grams/square meter. This is calculated using the 0.0103 square meter area noted above.

(c) Caliper

Preconditioned samples are cut to a size greater than the size of the foot used to measure the caliper. The foot to be used is a circle with an area of 3.14 square inches.

The sample is placed on a horizontal flat surface and confined between the flat surface and a load foot having a horizontal loading surface, where the load foot loading surface has a circular surface area of about 3.14 square inches and applies a confining pressure of about 15 g/cm^2 (0.21 psi) to the sample. The caliper is the resulting gap between the flat surface and the load foot loading surface. Such measurements can be obtained on a VIR Electronic Thickness Tester Model II available from Thwing-Albert, Philadelphia, Pa. The caliper measurement is repeated and recorded at least five times. The result is reported in millimeters.

The sum of the readings recorded from the caliper tests is divided by the number of readings recorded. The result is reported in millimeters (mm).

(d) Compressibility

Compressibility is determined by subjecting a stack of 8 samples of the tissue product to a given pressure and observing the linear distance that a moveable plane is displaced from a parallel surface by the stack of samples. For the stack of 8 samples of the tissue product of the present invention, the linear distance displaced is at least about 0.080 inches. Compressibility is measured in terms of percent compression by the following expression:

$$\text{Percent Compression} = \frac{T1 - T2}{T1} \times 100$$

Where:

$T1$= original thickness of 8 samples of the tissue product (@ 0.05 psi)

$T2$= compressed thickness of 8 samples of the tissue product (@ 1 psi)

and

$T1\text{-}T2 \geq 0.080$ inches

(e) Resiliency

For the present invention, resiliency of the tissue product is measured in terms of

terms of its ability to rebound or recover from a compressed state. The average compression and rebound is determined by observing the linear distance that a moveable plane is displaced from a parallel surface by the tissue product while under a specified pressure and the linear distance recovered after a specified time interval that the pressure is removed. The percent recovery is determined by the following expression:

$$\text{Percent Rebound} = {T_3}/{T_1} \times 100$$

Where:

T1= original thickness of 8 samples of the tissue product (@ 0.05 psi).

T3 = recovered thickness of 8 samples of the tissue product (@ 0.05 psi).

Cyclic Test For Measuring Percent Compression And Percent Rebound:

Samples are cut to 4" x 4". A stack of eight samples are used for each test. The samples are then placed on a flat surface. The initial height of the stack is measured using a digital linear gauge. The foot on the digital gauge has a diameter of 1.56" and weighs 40 grams resulting in a pressure of .05 psi on the stack. On a pneumatic platform a load 863 grams of weight is placed, which yields a pressure of 1 psi when placed on the sample. The height of the sample is measured without the load, the load is applied for one second and then removed. The height of the stack is measured throughout the test. Based on the stack heights measured, the % compression and % rebound can be calculated using the expressions provided above.

(f) Rigidity

Equipment for Measuring Rigidity:

Rigidity of the tissue product is measured using a Pure Bending Test to determine the bending stiffness using a KES-FB2 Pure Bending Tester. The Pure Bending Tester is an instrument in the KES-FB series of Kawabata's Evaluation System. The unit is designed to measure basic mechanical properties of fabrics, non-wovens, papers and other film-like materials, and is available from Kato Tekko Co. Ltd., Kyoto, Japan.

The bending property is important for evaluating reinforcing structures and is one

of the valuable methods for determining stiffness. The cantilever method has been used for measuring the properties in the past. The KES-FB2 tester is a instrument used for pure bending tests. Unlike the cantilever method, this instrument has a special feature. The whole tissue product sample is bent accurately in an arc of constant radius, and the angle of curvature is changed continuously.

Method for Measuring Rigidity:

Tissue product samples are cut to approximately 15.2 x 20.3 cm in the machine and cross machine direction respectively. Each sample in turn is placed in the jaws of the KES-FB2 such that the sample would first be bent with the first surface undergoing tension and the second surface undergoing compression. In the orientation of the KES-FB2 the first surface is right facing and the second surface is left facing. The distance between the front moving jaw and the rear stationary jaw is 1 cm. The sample is secured in the instrument in the following manner.

First the front moving chuck and the rear stationary chuck are opened to accept the sample. The sample is inserted midway between the top and bottom of the jaws. The rear stationary chuck is then closed by uniformly tightening the upper and lower thumb screws until the sample is snug, but not overly tight. The jaws on the front stationary chuck are then closed in a similar fashion. The sample is adjusted for squareness in the chuck, then the front jaws are tightened to insure the sample is held securely. The distance (d) between the front chuck and the rear chuck is 1 cm.

The output of the instrument is load cell voltage (Vy) and curvature voltage (Vx). The load cell voltage is converted to a bending moment (M) normalized for sample width in the following manner:

$$\text{Moment } (M, \text{gf*cm}^2/\text{cm}) = (Vy * Sy * d)/W$$

where Vy is the load cell voltage,

Sy is the instrument sensitivity in gf*cm/V,

d is the distance between the chucks,

and W is the sample width in centimeters.

The sensitivity switch of the instrument is set at 5 x 1. Using this setting the instrument is calibrated using two 50 gram weights. Each weight is suspended from a thread. The thread is wrapped around the bar on the bottom end of the rear stationary chuck and hooked to a pin extending from the front and back of the center of the shaft. One weight thread is wrapped around the front and hooked to the back pin. The other weight thread is wrapped around the back of the shaft and hooked to the front pin. Two pulleys are secured to the instrument on the right and left side. The top of the pulleys are horizontal to the center pin. Both weights are then hung over the pulleys (one on the left and one on the right) at the same time. The full scale voltage is set at 10 V. The radius of the center shaft is 0.5cm. Thus the resultant full scale sensitivity (Sy) for the Moment axis is 100gf*0.5cm/10V (5gf*cm/V).

The output for the Curvature axis is calibrated by starting the measurement motor and manually stopping the moving chuck when the indicator dial reached 1.0cm-1. The output voltage (Vx) is adjusted to 0.5 volts. The resultant sensitivity (Sx) for the curvature axis is 2/(volts*cm). The curvature (K) is obtained in the following manner:

Curvature (K, cm-1) = Sx * Vx

where Sx is the sensitivity of the curvature axis

and Vx is the output voltage

For determination of the bending stiffness the moving chuck is cycled from a curvature of 0 cm^{-1} to + 1 cm^{-1} to -1 cm^{-1} to 0 cm^{-1}at a rate of 0.5 cm-1/sec. Each sample is cycled continuously until four complete cycles are obtained. The output voltage of the instrument is recorded in a digital format using a personal computer. A typical output for a bending stiffness test is shown in Figure 4. At the start of the test there is no tension on the sample. As the test begins the load cell begins to experience a load as the sample is bent. The initial rotation is clockwise when viewed from the top down on the instrument.

In the forward bend the first surface of the fabric is described as being in tension and the second surface is being compressed. The load continued to increase until the bending curvature reached approximately +1cm^{-1} (this is the Forward Bend (FB) as shown in Figure 4). At approximately +1cm^{-1} the direction of rotation is reversed. During

the return the load cell reading decreases. This is the Forward Bend Return (FR). As the rotating chuck passes 0 curvature begins in the opposite direction, that is the sheet side now compresses and the no-sheet side extends. The Backward Bend (BB) extended to approximately -1 cm^{-1} at which the direction of rotation is reversed and the Backward Bend Return (BR) is obtained.

Referring to Figure 5, the data is analyzed in the following manner. A linear regression line is obtained between approximately 0.2 and 0.7cm^{-1} for the Forward Bend (FB) and the Forward Bend Return (FR). A linear regression line is obtained between approximately -0.2 and -0.7cm^{-1} for the Backward Bend (BB) and the Backward Bend Return (BR). The slope of the line is the Bending Stiffness (B). It has units of gf*cm^2/cm.

This is obtained for each of the four cycles for each of the four segments. The slope of the each line is reported as the Bending Stiffness (B). It has units of gf*cm^2/cm. The Bending Stiffness of the Forward Bend is noted as BFB. The individual segment values for the four cycles are averaged and reported as an average BFB, BFR, BBF, BBR. Two separate samples in the MD and the CD are run. Values for the two samples are averaged together. MD and CD values are reported separately. The values are reported in Table 2.

Table 2: Bending Stiffness (Rigidity) Values

		Bending Stiffness (gf*cm^2/cm)				
SAMPLE	MD/CD	AVG BFB	AVG BFR	AVG BBF	AVG BBR	AVG AVG
Puffs SS	MD	-.003	.014	.008	.001	.008
Puffs Basic	CD	.024	.028	.017	.007	.018
Puffs AES	MD	.049	.055	.025	.040	.042
Puffs AES	CD	.033	.038	.017	.025	.028
Code 10	MD	.092	.104	.074	.084	.088
Code 10	CD	.143	.134	.107	.121	.126
Code 13	MD	.239	.275	.227	.200	.235
Code 13	CD	.380	.413	.376	.321	.373
Air Laid Pulp	MD	.067	.067	.055	.052	.060

Air Laid Pulp	CD	.072	.071	.061	.047	.063
Cotton	MD	.090	.099	.079	.068	.084
Cotton	CD	.123	.118	.117	.093	.169

Puffs SS - currently marketed product as Puffs Soft and Strong

Puffs AES - currently marketed product as Puffs Advanced Extra Strength

Code 10 - two cellulosic outer plies made using a through air dried process with a cellulosic inner layer calendered @ 400 psi

Code 13 - four cellulosic plies made using a through air dried process

Air Laid Pulp - two cellulosic outer plies made using a conventional process with air laid dry pulp fibers as the middle layer

Cotton - two cellulosic outer plies made using a conventional process with cotton batting as the middle layer

(g) Absorbency

Absorbency of the tissue product is determined using a system designed specifically for measuring water absorbency (i.e. both rate and capacity) of the tissue product. The wicking of water into a sample of the tissue product is measured as water gain (weight) with time.

This test measures the absorbent rate and capacity of paper products, specifically paper towels, facial tissue, toilet tissue and napkin products. A circle 3 inches in diameter is cut from the center of the test product. The test sample is then placed in a on an open weave net suspended from a top loading balance. The center of the test sample is then allowed to touch a water source and water is then wicked into the sample. The wicking of water continues until a pre-set time. The water absorbed by the sample (weight gain) is measured over time. The test provides the absorbent rate of the sample in g/sec and the absorbent capacity of the sample in grams of fluid/gram of sample.

Data points (i.e. weight and time) are collected and analyzed by a computer program. For each of the data points, the following calculation is made (all units are grams):

$$\text{Absorptive capacity} = {}^{(\text{Sample Wet Weight} - \text{Sample Dry Weight})}\!/_{\text{Sample Dry Weight}}$$

The computer program repeats the calculation for each data point. Each of the data points are averaged together and reported as ${}^{g_{Water}}\!/_{g_{Dry\ Structure}}$ (grams of water / grams of sample dry weight).

While particular embodiments of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention. It is intended to cover in the appended claims all such changes and modifications that are within the scope of the invention.

What Is Claimed Is:

1. A tissue product comprising two outer cellulosic plies; and an inner layer interposed between the two outer plies, the inner layer comprises passively bonded, hydrophilic fibers.

2. A tissue product comprising two outer cellulosic plies; and an inner layer interposed between the two outer plies, the inner layer comprising cotton.

3. A tissue product comprising two outer cellulosic plies; and an inner layer comprising passively bonded, hydrophilic fibers, the inner layer has an apparent density that is less than about 0.11 g/cm^3 and a caliper ranging from about 0.017 inches to about 0.028 inches.

4. A tissue product having a compressibility ranging from 20% to about 99%, the tissue product comprising two outer cellulosic plies; and an inner layer comprising actively bonded, hydrophilic fibers, the inner layer has an apparent density that is less than about 0.11 g/cm^3 and a caliper ranging from about 0.017 inches to about 0.028 inches.

5. The tissue product of Claim 1, wherein the compressibility ranges from about 20% to about 99%.

6. The tissue product of Claim 1, having a percent rebound ranging from about 30% to about 99%.

7. The tissue product of Claim 1 wherein the surface area is less than about 70 $inches^2$.

8. The tissue product of Claim 1 having a total caliper wherein the total caliper ranges from about 0.026 inches to about 0.044 inches.

9. The tissue product of Claim 3, wherein the compressibility ranges from about 20% to about 99%.

10. The tissue product of Claim 4, wherein the percent rebound ranges from about 30% to about 99%.

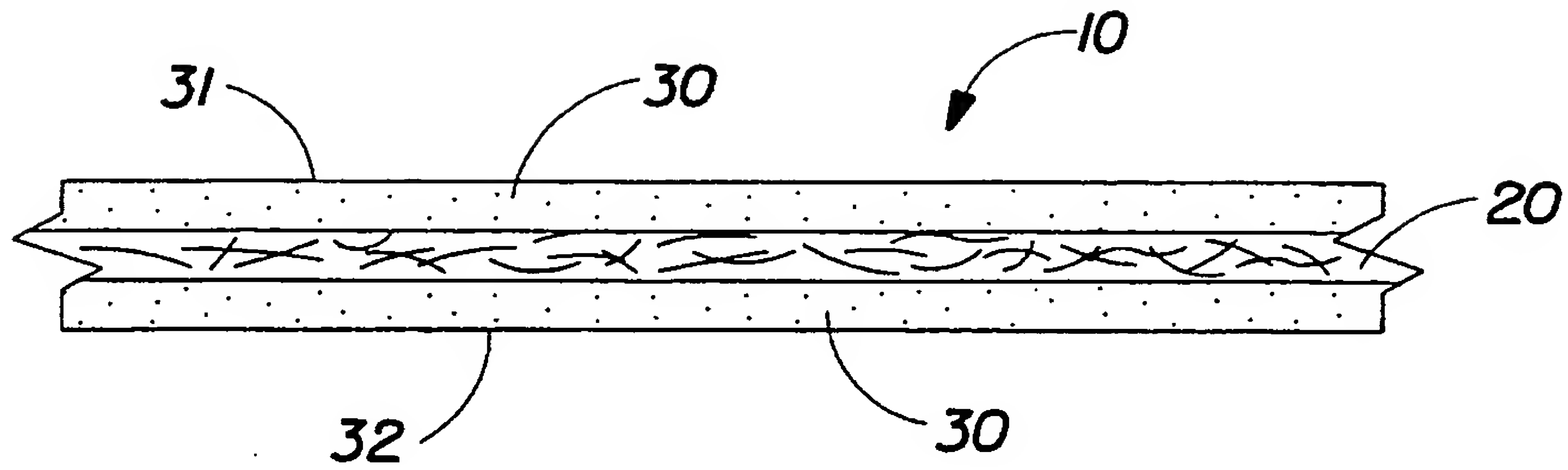


FIG.1

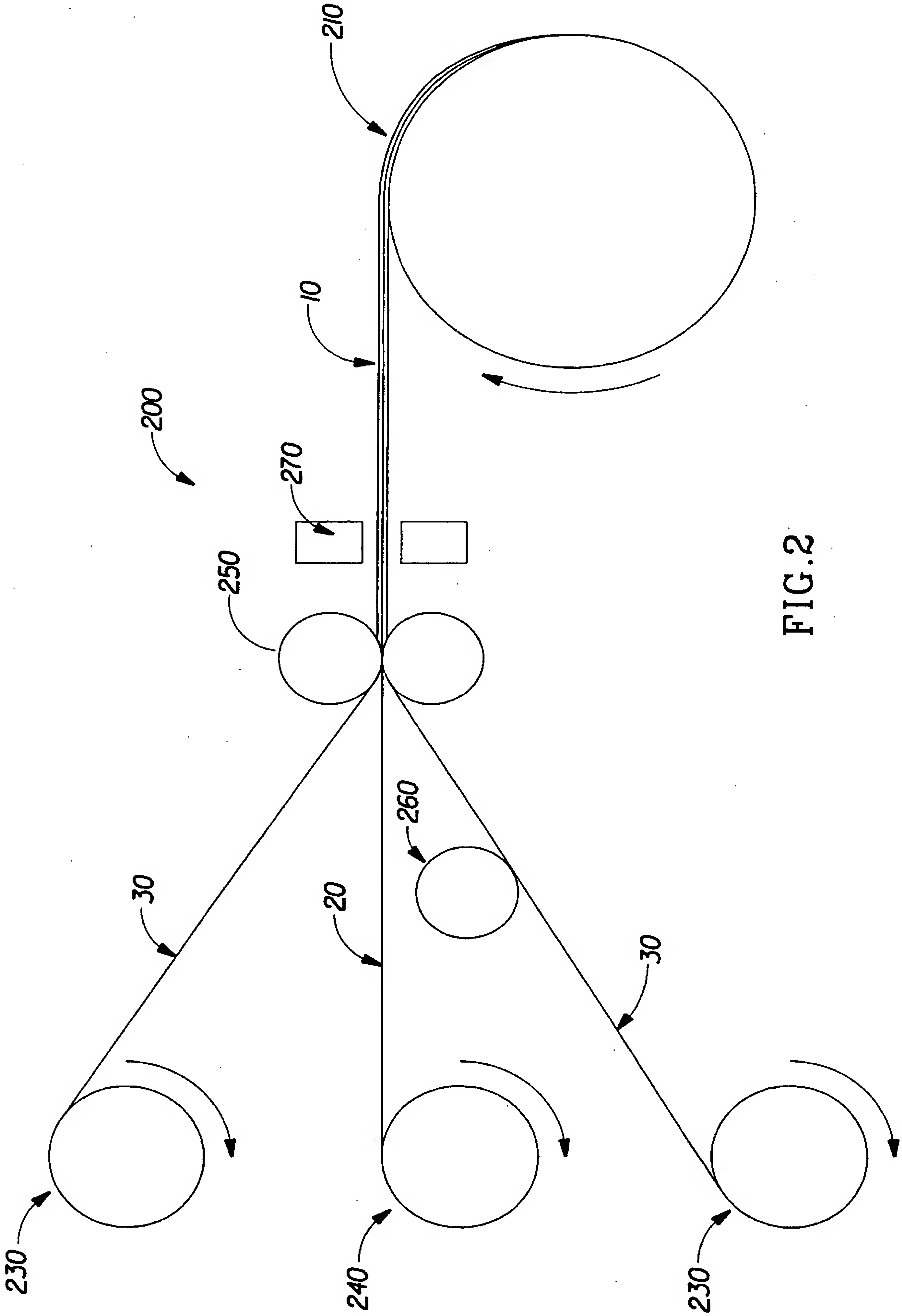


FIG.2

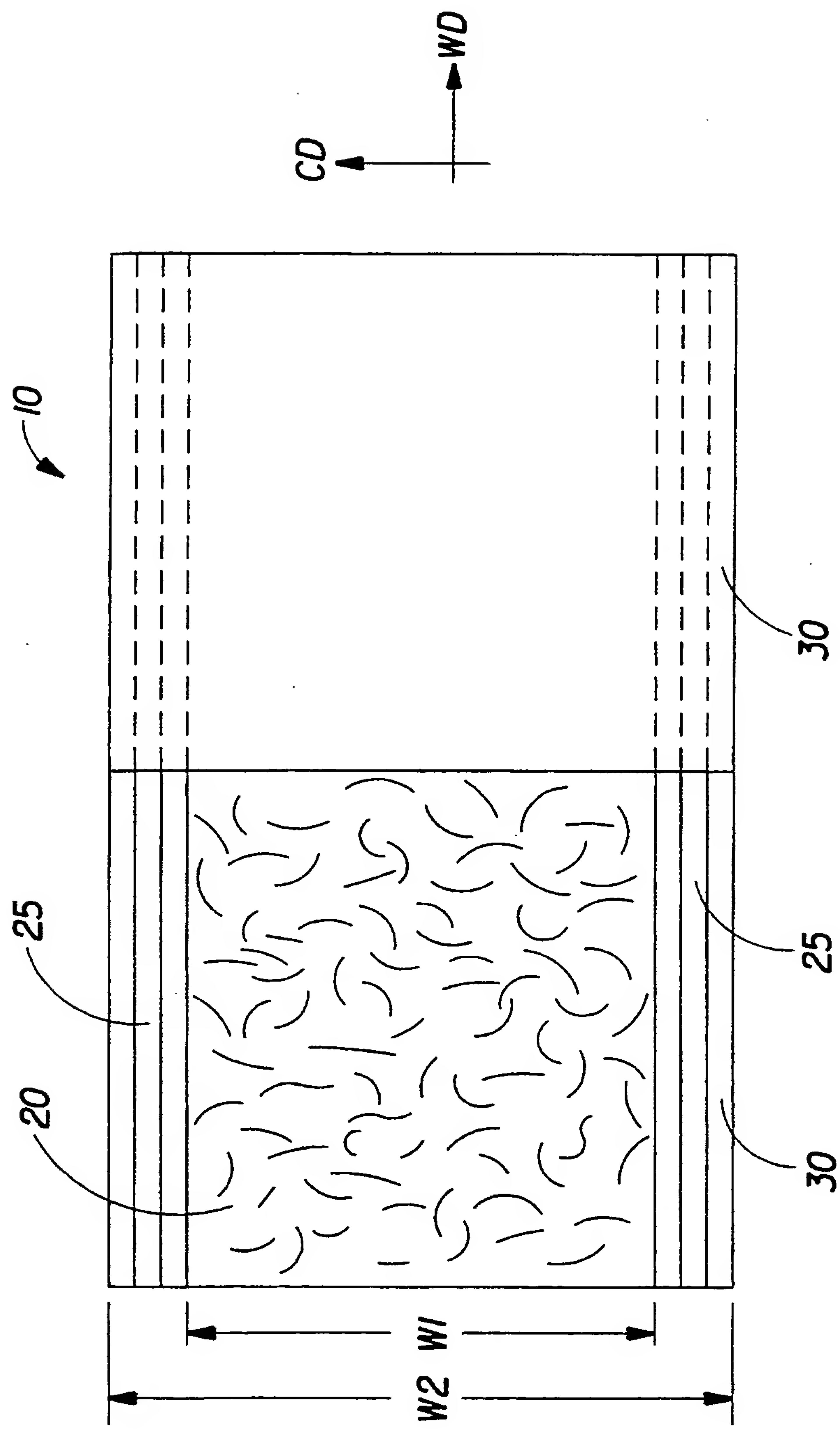


FIG.3

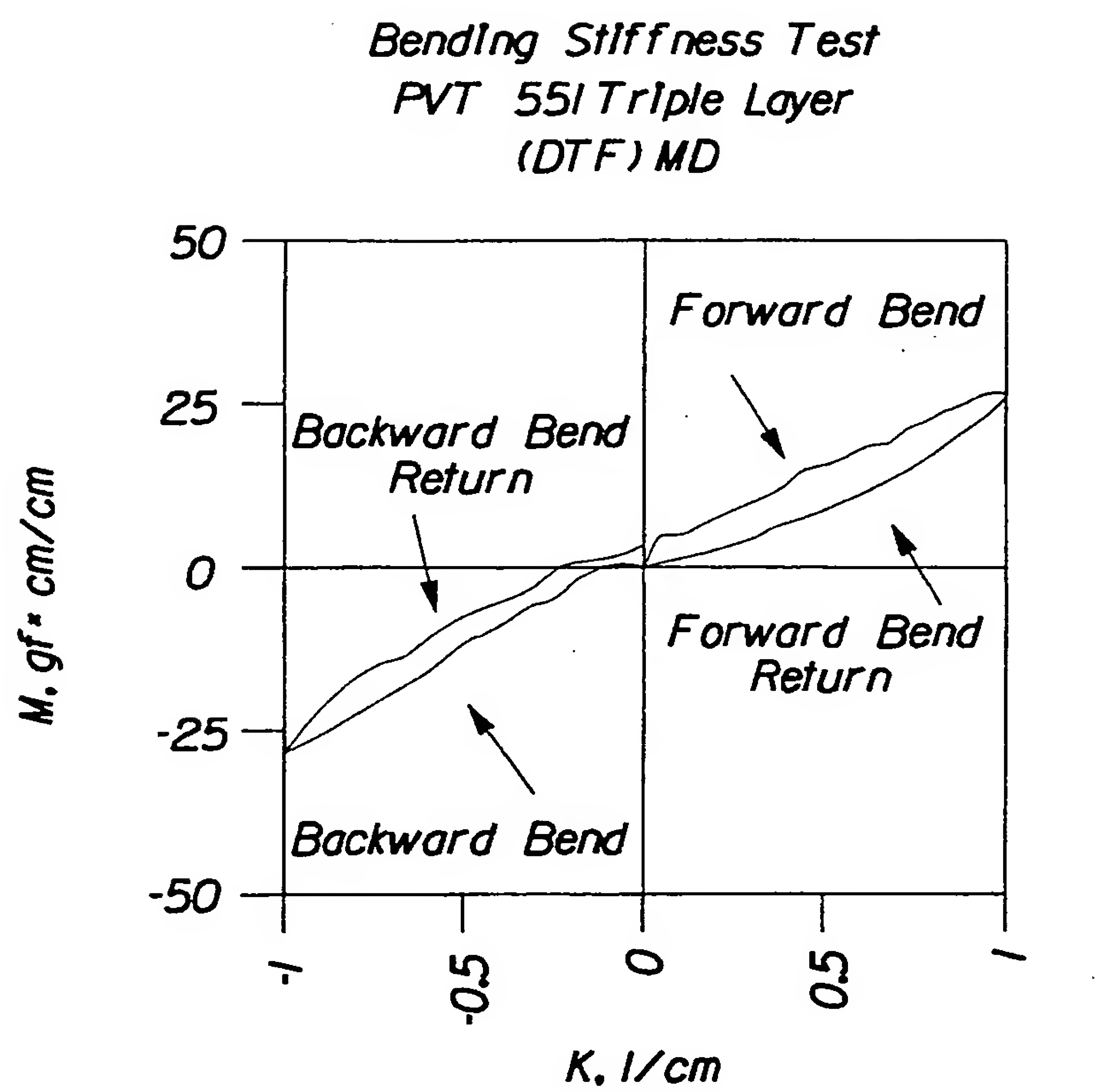

Bending Stiffness Test
PVT 551 Triple Layer
(DTF) MD
50
25
0
-25
-50
M, gf* cm/cm
Forward Bend
Backward Bend Return
Forward Bend Return
Backward Bend
-1
-0.5
0
0.5
1
K, 1/cm

FIG.4

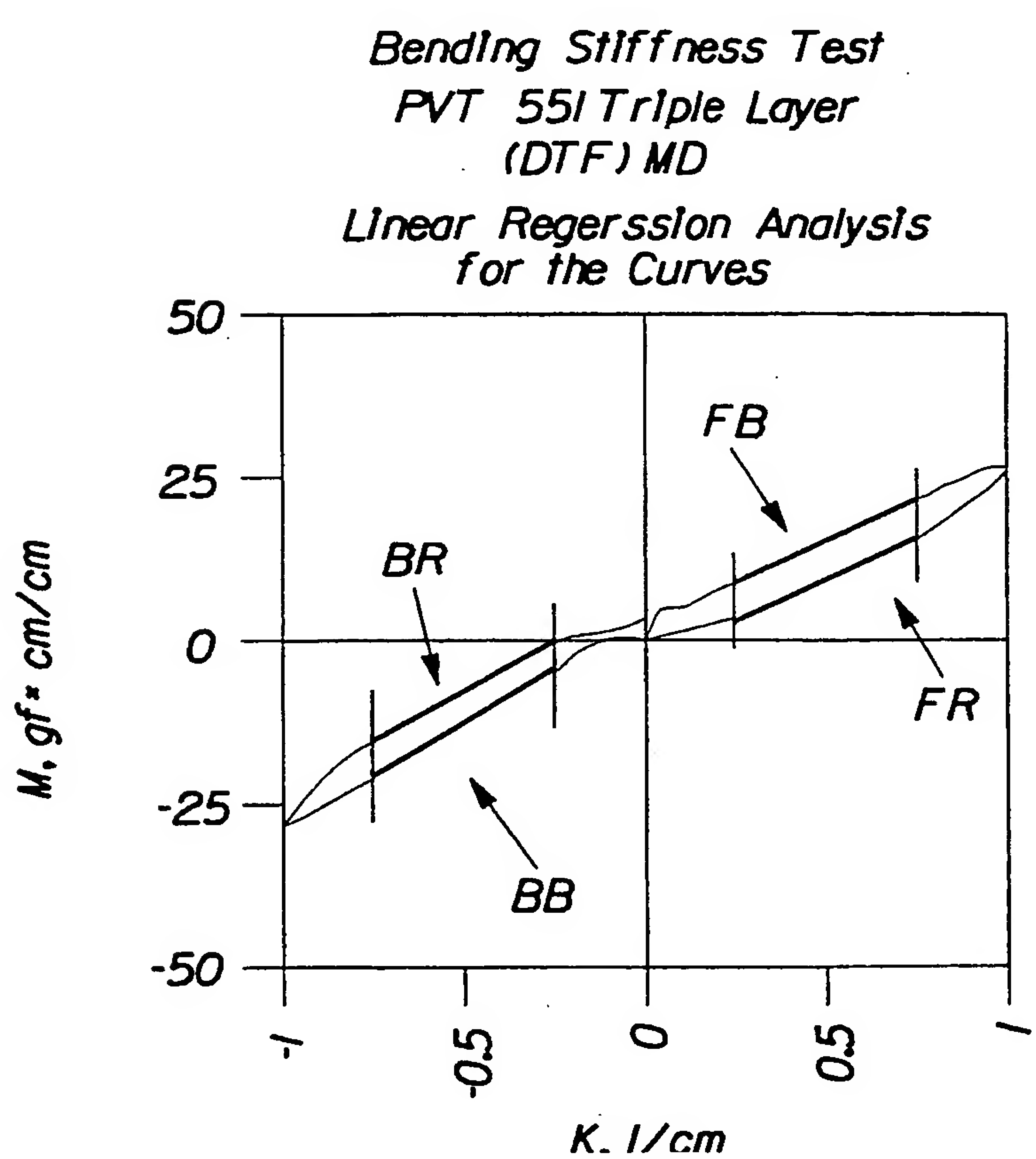

Bending Stiffness Test
PVT 551 Triple Layer
(DTF) MD
Linear Regerssion Analysis
for the Curves
50
25
0
-25
-50
M, gf* cm/cm
FB
BR
FR
BB
-1
-0.5
0
0.5
1
K, 1/cm

FIG.5

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 00/22691

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 D21H27/32 D21H27/38 B32B29/00 //D21H11/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 D21H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	GB 1 237 489 A (AB KLIPPANS PINPAPPERSBRUK) 30 June 1971 (1971-06-30) page 3, line 28 - line 38; claim 1; figure 1	1 3,4
A	WO 98 17864 A (PROCTER & GAMBLE) 30 April 1998 (1998-04-30) page 6, line 23 -page 7, line 27	1,3,4
A	EP 0 531 112 A (TOYO PAPER MFG CO LTD ;JUJO KIMBERLY KK (JP)) 10 March 1993 (1993-03-10) the whole document	4
P,A	FR 2 775 698 A (FORT JAMES FRANCE) 10 September 1999 (1999-09-10) the whole document	4

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 November 2000	24/11/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Songy, O

1

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/US 00/22691

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 1 362 666 A (JOHNSON & JOHNSON) 7 August 1974 (1974-08-07)	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 00/22691

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 1237489 A	30-06-1971	SE 339398 B	04-10-1971
		AT 299680 B	15-05-1972
		BE 741131 A	01-04-1970
		CH 514733 A	31-10-1971
		DE 1953878 A	18-06-1970
		FI 49198 B	31-12-1974
		FR 2023594 A	21-08-1970
		NL 6917415 A	21-05-1970
WO 9817864 A	30-04-1998	AU 4742997 A	15-05-1998
		BR 9712644 A	26-10-1999
		CN 1237217 A	01-12-1999
		EP 0951603 A	27-10-1999
		JP 2000505157 T	25-04-2000
EP 0531112 A	10-03-1993	AT 164407 T	15-04-1998
		AU 658213 B	06-04-1995
		AU 2201792 A	11-03-1993
		CA 2077239 A,C	03-03-1993
		DE 69224863 D	30-04-1998
		DE 69224863 T	20-08-1998
		JP 5237043 A	17-09-1993
		KR 9615818 B	21-11-1996
		US 5437908 A	01-08-1995
FR 2775698 A	10-09-1999	WO 9945205 A	10-09-1999
GB 1362666 A	07-08-1974	DE 2200244 A	02-08-1973
		FR 2171603 A	21-09-1973
		NL 7200197 A	10-07-1973